CLAIMS

1. An expander having at least a plurality of operating chambers (25, 45) for expanding a high-pressure operating fluid and a shaft (26, 46) for obtaining a rotating power by means of expansion of the operating fluid in the operating chambers (25, 45), wherein

a plurality of discharge ports (28, 29, 48, 49, 50) comprising a discharge port (28, 48) which firstly communicates to the operating chamber (25, 45) involving in a discharging process and a discharge port (29, 49, 50) which secondly communicates to the same operating chamber (25, 45) are provided, and at least the firstly communicating discharge port (28, 48) is provided with a valve mechanism (30a, 30b, 51a, 51b) for preventing the operating fluid from flowing back.

2. A vane rotary expander comprising: a cylinder (21, 41) having a cylindrical inner wall (21a, 41a); side plates closing its both ends; a rotor (23, 43) disposed in the cylinder (21, 41), an outer circumferential segment of the rotor (23, 43) defining a small clearance (22, 42) together with the inner wall (21a, 41a) of the cylinder; vanes (24, 44) inserted into vane grooves (23a, 43a) formed in the rotor (23, 43) at respective ends thereof so as to be freely slidable, the other ends of the vanes (24, 44) being in contact with the inner wall (21a, 41a)

of the cylinder to form a plurality of operating chambers (25, 45) between the cylinder (21, 41) and the rotor (23, 43); and a shaft (26, 46) integrally formed with the rotor (23, 43), the shaft being rotatably supported by means of an axis, wherein

a power for rotating the shaft (26, 46) is obtained by expanding a high-pressure operating fluid in the operating chamber (25, 45), a plurality of discharge ports (28, 29, 48, 49, 50) comprising a discharge port (28, 48) which firstly communicates to the operating chamber (25, 45) involving in a discharging process and a discharge port (29, 49, 50) which secondly communicates to the same operating chamber (25, 45) are provided in the cylinder (21, 41) in a circumferential direction, and at least the firstly communicating discharge port (28, 48) is provided with a valve mechanism (30a, 30b, 51a, 51b) for preventing the operating fluid from flowing back.

3. The vane rotary expander according to claim 2, wherein when the number of the vanes (24, 44) is n, the firstly communicating discharge port (28, 48) is formed in the cylinder (21, 41) at a position of approximate {180 x (1 + 1/n)} degrees from the small clearance (22, 42) in a direction where the shaft (26, 46) rotates, and the succeedingly communicating discharge port (29, 49, 50) is formed in the cylinder (21, 41) at any position in an area from an angle of approximate {180 x (1 + 1/n)} degrees to an angle of 360 degrees from the small clearance

(22, 42) in the direction where the shaft (26, 46) rotates.

4. The vane rotary expander according to claim 3, wherein a central angle around the shaft (26, 46) on the cylinder (21, 41) between the firstly communicating discharge port (28, 48) and the succeeding communicating discharge port (29, 49, 50) and/or between the succeeding communicating discharge ports (49, 50) is smaller than or equal to (360/n) degrees.

5. The vane rotary expander according to any one of claims 1 to 4, wherein the expander is operated by means of an operating fluid expanding into a gas-liquid two phase from a liquid phase or a supercritical phase.

6. The vane rotary expander according to any one of claims 1 to 4, wherein the expander is operated by means of an operating fluid containing carbon dioxide as a main component.